EPA New England Illicit Discharge Detection & Elimination (IDDE) Protocol
December 2008

Purpose

This document provides a common framework for EPA New England ("EPA-NE") communities to develop and implement a comprehensive plan to identify and eliminate dry and wet weather illicit discharges to their separate storm sewer systems. Adopted from BWSC (2004), Pitt (2004), and based upon fieldwork conducted and data collected by EPA-NE, the protocol relies primarily on visual observations and the use of field test kits and portable instrumentation during dry weather to complete a thorough inspection of the communities' storm sewers in a prioritized manner. The protocol is applicable to most typical storm sewer systems, however modifications to materials and methods may be required to address situations such as open channels, systems impacted by sanitary sewer overflows or sanitary sewer system under drains, or situations where groundwater or backwater conditions preclude adequate inspection. The primary focus of the protocol is sanitary waste, however, toxic and nuisance discharges may also be identified. EPA has established the protocol as the expected standard of practice for EPA-NE communities. Implementation of the protocol will assist in compliance with the Illicit Discharge Detection and Elimination ("IDDE") provisions of the NPDES Small MS4 General Permit.

Introduction

The protocol is structured into several phases of work that progress logically through elements of mapping, prioritization, investigation, removal, verification, and monitoring. Each community should assess their current IDDE Program and identify where it has or has not successfully satisfied the elements of the protocol. In modifying their IDDE Programs to become consistent with the protocol, communities may need to refine particular elements or phases of the protocol to accommodate their institutional constraints or preferences. Regardless, the rigor and comprehensive nature of the protocol must remain unchanged.

Step I - Mapping

The goal of the requisite mapping is the comprehensive depiction of key infrastructure and factors influencing proper system operation and the potential for inappropriate sanitary sewer discharges. The required scale, detail, and number of maps should be appropriate to facilitate a rapid understanding of the system by the municipality and regulators, serve as a planning tool for the implementation and phasing of investigations, and demonstrate the extent of completed and planned investigations and corrections, and other related capital projects. Further, municipal representatives, community members, or regulatory personnel must be able, using a publicly available version of the map, to locate and identify all stormwater outfalls in the field with reasonable effort. To ensure legible mapping, information should be grouped appropriately and represented thematically (e.g. by color) with legends or schedules where possible. Mapping should be updated as necessary to reflect newly discovered information, corrections or modifications, and progress made. The following information and features should be considered for inclusion in the mapping:

Infrastructure

- Municipal storm sewer system (including inter-municipal and private connections where available)
- Municipal sanitary sewer system (including inter-municipal connections)
- Municipal combined sewer system (if applicable)
- Thematic representation (with legend) of sewer material, size, and age
- Sewer flow direction and flow type (pressure v. gravity)
- Rim and invert elevations for select structures (for comparison with water table and vertical separation between systems)
- MWRA interceptor alignment(s) and connect point(s)
- Aerial delineations of major separate storm sewer catchment areas, sanitary sewersheds, combined sewersheds, and areas served by on-site subsurface disposal systems
- Common manholes or structures (structures serving or housing both separate storm and sanitary sewers)
- Sanitary and storm sewer alignments served by known or suspected underdrain systems
- Sewer alignments with common trench construction and major crossings representing high potential for communication due to water table
- Lift stations (public and private), siphons, and other key sewer appurtenances
- Sewersheds or sewer alignments experiencing inadequate level of service (LOS) (with indication of reason(s))
- Location(s) of known sanitary sewer overflows (SSO) (with indication of cause(s))

Water Resources and Topographic Features

- Water bodies and watercourses identified by name
- Seasonal high water table elevations or sanitary sewer alignments impacted by groundwater
- Topography
- Orthophotographic overlays

O&M, Investigations, Remediation, and Capital Projects

- Alignments, dates, and thematic representation of work completed (with legend) of past illicit connection investigations (e.g. flow isolation, dye testing, CCTV, etc.)
- Locations of suspected, confirmed, and corrected illicit connections (with dates and flow estimates)
- Water quality monitoring locations with graphical indication of indicator concentrations
- Recent and planned sewer infrastructure cleaning and repair projects
- Alignments and dates of past and planned I/I investigations and sanitary sewer remediation work
- Planned capital projects relative to utility and roadway rehabilitation or replacement
- Proposed phasing of future IDDE investigations

Step II - Drainage Area/Outfall Prioritization

Whether documented by EPA, the permittee, or others, drainage catchments or alignments with known or suspected contributions of illicit flows may have already been identified in some instances. Additional investigation or removal procedures should proceed immediately in these areas.

Where a municipality has little or no specific knowledge of potential illicit contributions to its storm sewer system, a system of prioritization for Step III investigations should be developed that is based on multiple-parameter outfall monitoring data (preferred), information collected during the mapping phase, or through a rapid screening and ranking process.

1. Outfall Monitoring Data

The preferred method of drainage area and outfall prioritization is through the collection and analyses of grab samples from outfalls during both dry and wet weather (See Step III for precise criteria). Measured values are then compared with benchmark values in Table 1 or by using the flow chart in Figure 1 to determine a priority ranking or tiers for further focused evaluation. Analyses of outfall samples for conventional indicator bacteria organisms (e.g. *E. coli*, enterococcus), in addition to surfactants and ammonia is the recommended minimum approach.

2. Mapping-Based Prioritization

Priority areas identified though mapping might include those:

- with direct discharges to critical or impaired waters (e.g. water supplies, swimming beaches);
- with inadequate sewer LOS, SSOs, or the subject of numerous/chronic customer complaints;
- served by common/twin-invert manholes or underdrains; and
- scheduled for near-term capital improvements (e.g., infrastructure improvements, paving)

3. Rapid-Assessment Prioritization

A municipality may alternatively choose to implement a screening and ranking process consisting of a rapid assessment of its storm sewer system through visual inspections and discharge monitoring at select locations. This approach would yield an understanding of the extent and degree of illicit contributions throughout the system, including identification of areas of significant and immediate concern. A municipality would then be enabled to rank areas and develop a budget and schedule for prioritized investigation and remediation. A screening process would include a simplified version of the Step III - Drainage Area Investigations effort described below, plus select dry weather monitoring for conventional indicator bacteria organisms (e.g. *E. coli*, enterococcus), surfactants, and ammonia. For example, a municipality could identify and visually inspect a limited number of stormwater structures within each major catchment area and test suspicious flows using field test kits or instrumentation. Concurrent sampling and analysis of conventional indicator organism densities at the same structures would assist in the identification of potentially significant sources of illicit contributions.

Step III - Drainage Area Investigations

1. Public Notification/Outreach Program

Provide letter/mailer to residents and building owners located within subject drainage basin, sewershed, or other targeted area notifying them of scope and schedule of investigative work, and the potential need to gain access to their property to inspect plumbing fixtures. Where necessary, notification of property owners through letter, door hanger, or otherwise will be required to gain

entry. Assessors' records will provide property owner identification.

2. Field verification and correction of sub-catchment storm sewer mapping

Adequate storm and sanitary sewer mapping is a prerequisite to properly execute an illicit discharge detection and elimination program. As necessary and to the extent possible, infrastructure mapping should be verified in the field and corrected prior to investigations. This effort affords an opportunity to collect additional information such as latitude and longitude coordinates using a global position system (GPS) unit if so desired. To facilitate subsequent investigations (see Part 5. below), tributary area delineations should be confirmed and junction manholes should be identified during this process. Orthophotographic coverages (available from previous engineering studies and such sources as MassGIS, NH GRANIT, or TerraServer) will also facilitate investigations by providing building locations and land use features.

3. Infrastructure cleaning requirements

To facilitate investigations, storm drain infrastructure should be evaluated for the need to be cleaned to remove debris or blockages that could compromise investigations. Such material should be removed to the extent possible prior to investigations, however, some cleaning may occur concurrently as problems manifest themselves.

4. Dry weather criteria

In order to limit or remove the influence of stormwater generated flows on the monitoring program, antecedent dry weather criteria need to be established. An often used metric is to sample when no more than 0.1 inches of rainfall have occurred in the previous 24-hour period; however, exact language in the applicable permit should be verified.

5. Manhole inspection and flow monitoring methodology

Beginning at the uppermost junction manhole(s) within each tributary area, drainage manholes are opened and inspected for visual evidence of contamination after antecedent dry weather conditions are satisfied (e.g. after 48 hours of dry weather). Where **flow is observed**, and determined to be contaminated through visual observation (e.g. excrement or toilet paper present) or field monitoring (see Part 6. below), the tributary storm sewer alignment is isolated for investigation (e.g. dye testing, CCTV; see Part 7. below). No additional downstream manhole inspections are performed unless the observed flow is determined to be uncontaminated or until all upstream illicit connections are identified and removed. Where **flow is not observed** in a junction manhole, all inlets to the structure are partially dammed for the next 48 hours when no precipitation is forecasted. Inlets are damned by blocking a minimal percentage (approximately 20% +/- depending on pipe slope) of the pipe diameter at the invert using sandbags, caulking, weirs/plates, or other temporary barriers. The manholes are thereafter reinspected (prior to any precipitation or snow melt) for the capture of periodic or intermittent flows behind any of the inlet dams. The same visual observations and field testing is completed on any captured flow,

and where contamination is identified, abatement is completed prior to inspecting downstream manholes.

In addition to documenting investigative efforts in written and photographic form, it is recommended that information and observations regarding the construction, condition, and operation of the structures also be compiled.

6. Field Measurement/Analysis:

Where flow is observed in the manhole and does not demonstrate obvious olfactory evidence of contamination, samples are collected and analyzed with field instruments identified in Table 1. Measured values are then compared with benchmark values in Table 1 or by using the flow chart in Figure 1 to determine the likely prominent source of the flow. This information facilitates the investigation of the upstream stormsewer alignment described in Part 7. Benchmark values may be refined over the course of investigations when compared with the actual incidences of observed flow sources. Concurrent sampling and analysis of conventional indicator organism (e.g. *E. coli*, enterococcus) densities at all or a subset of the same structures will assist greatly in the identification of potentially significant sources of illicit contributions.

In those manholes where periodic or intermittent flow is captured through damming inlets, additional laboratory testing (e.g. toxicity, metals, etc.) should be considered where an industrial batch discharge is suspected for example.

7. Isolation and confirmation of illicit sources

Where field monitoring has identified storm sewer alignments to be influence by sanitary flows or washwaters, the tributary area is isolated for implementation of more detailed investigations. Additional manholes along the tributary alignment are inspected to refine the longitudinal location of potential contamination sources (e.g. individual or blocks of homes). Targeted internal plumbing inspections/dye testing or CCTV inspections are then employed to more efficiently confirm discrete flow sources.

8. Post-Removal confirmation

After completing the removal of illicit discharges from a sub-catchment area and before beginning the investigation of downstream areas, the sub-catchment area is reinspected to verify corrections. Depending on the extent and timing of corrections, verification monitoring can be done at the initial junction manhole or the closet downstream manhole to each correction. Verification is accomplished by using the same visual inspection, field monitoring, and damming techniques as described above.

Since verification of illicit discharges removals is required prior to progressing downstream through the storm sewer system, consideration must be given to providing adequate staffing and equipment resources to initiate investigations in other subareas to facilitate progress while

awaiting completion of corrections.

Table 1 – Freshwater Water Quality Criteria, Benchmark levels of other indicators, and available field instrumentation

Analyte/ Indicator	Geometric mean	Benchmark/ Single Sample[3]	Instrumentation
E. coli[2]	126[b] cfu/100ml	235 cfu/100ml	
Enterococci[2]	33[b] cfu/100ml	61 cfu/100ml	
Surfactants (as MBAS)	--	0.25 mg/l	MBAS Test Kit (e.g. CHEMetrics K-9400)
Ammonia (NH_3)	--	0.5 mg/l	Portable Ion Meter (e.g. Horiba Cardy C-131)
Potassium (K)	--	(ratio below)	Portable Colorimeter or Photometer (e.g. Hach DR/890, CHEMetrics V-2000)
Fluoride (F)	--	>0.25 mg/L	Portable Colorimeter or Photometer (e.g. Hach DR/890, CHEMetrics V-2000)
Temperature	--	≥ 83°F(28.3°C) and change 5°C(2.8°C) in rivers[2]	Thermometer
pH	--	Outside of 6.5 and 8[2]	pH Meter

[2] 314 CMR 4.00 MA - Surface Water Quality Standards - Class B Waters.
[3] Potential wastewater or washwater contamination
[b]Geometric mean of the most recent five samples collected within the same bathing season

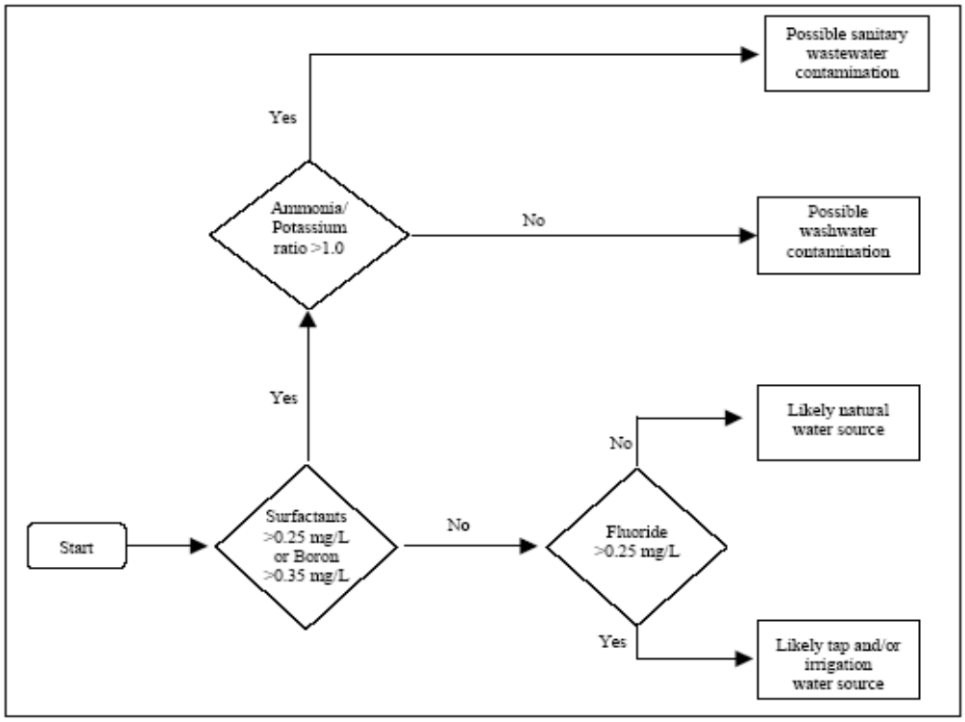

Figure 1. Flow Chart for Determining Likely Source of Discharge (Pitt, 2004)

Step IV - Outfall Monitoring

Upon conclusion of investigations and removal of identified illicit discharges, municipalities should measure program success and compliance with bacteriological water quality standards through initiation of a regular outfall monitoring program. In addition to supporting the confirmation of successful removal of illicit discharges identified during Phase III, ongoing monitoring can facilitate discovery of new illicit discharges as they occur as a result of redevelopment, infrastructure deterioration, or otherwise.

Municipalities should design and implement their program to monitor all stormwater outfalls on an annual basis during dry and wet weather conditions. EPA recommends analyzing grab samples for either *E.coli* or enterococcus as appropriate, in addition to surfactants, and ammonia. Water quality criteria for these indicators are provided in Table 1. Outfalls that exhibit substantially elevated densities of indicator organisms should be reinvestigated using the IDDE Protocol. Obviously, elevated densities of indicator organisms combined with elevated levels of ammonia or surfactants, or both, significantly increase confidence in the suspected source and greatly assist in prioritizing outfalls for further study.

Program Evaluation

The success and progress of a municipality's IDDE program can be represented by improvements in receiving water quality. Progress and success of the program can also be evaluated by tracking a variety of metrics including:

- Percentage of manholes/structures inspected
- Percentage of outfalls screened
- Percentage of home plumbing inspections/dye tests completed
- Percentage of pipe inspected by CCTV
- Number (and relative percentage) of illicit discharges identified through:
  -visual inspections; field testing results; and temporary damming procedures
- Number of illicit discharges removed
- Cost of illicit discharge removals (total and average unit cost)
- Estimated flow or volume of illicit discharges removed
- Estimated flow or volume of inflow/infiltration removed
- Percentage of infrastructure jetting/cleaning completed
- Infrastructure defects identified or repaired
- Number and estimated flow of water main breaks identified or repaired

References Cited

Boston Water & Sewer Commission, 2004, *A systematic Methodology for the Identification and Remediation of Illegal Connections.* 2003 Stormwater Management Report, chap. 2.1.

Pitt, R. 2004 *Methods for Detection of Inappropriate Discharge to Storm Drain Systems. Internal Project Files*. Tuscaloosa, AL, *in* The Center for Watershed Protection and Pitt, R., *Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments*: Cooperative Agreement X82907801-0, U.S. Environmental Protection Agency, variously paged. Available at: http://www.cwp.org.

Instrumentation Cited (Manufacturer URLs)

MBAS Test Kit - CHEMetrics K-9400: http://www.chemetrics.com/Products/Deterg.htm

Portable Photometer - CHEMetrics V-2000: http://www.chemetrics.com/v2000.htm

Portable Colorimeter - Hach DR/890: http://www.hach.com/

Portable Ion Meter: Horiba Cardy C-131: http://www.wq.hii.horiba.com/c.htm

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